

ZOOLOGY.—*Earthworms of the Northeastern United States: A key, with distribution records.*¹ THEODORE H. EATON, Jr., Cornell University. (Communicated by G. ARTHUR COOPER.)

In the States east of the Mississippi River and north of Virginia about 17 species of native earthworms are found, with about 13 more believed to have been introduced from Europe. They belong to four families; the great majority, including all the introduced species, are Lumbricidae. Information about these earthworms is too scattered to be of much help to a general biologist, agronomist, or forester who wishes to identify the species he finds or uses in the laboratory. Most of the papers on earthworms are taxonomic and concerned with a small area or with a limited group. It seemed, therefore, that a key based so far as possible on external features, and accompanied by descriptive and distributional notes, might be useful.

Distribution records already published are cited by State or country, followed by an abbreviation in parentheses of the author's name and the year of publication, given in full in the bibliography. Names thus abbreviated are the following: Gates (G), Heimburger (H), Olson (O), Smith (S).

Distribution records given as new are based upon specimens that I have collected or have seen in collections, and for the determination of which I therefore am responsible. The sources of these are likewise abbreviated in parentheses. (E) refers to my own collection; (AM) the collection of the American Museum of Natural History, specimens being lent through the kindness of Dr. W. G. Van Name, associate curator of invertebrates; (FC) the collection made by Dr. C. E. Johnson, of the New York State College of Forestry, Syracuse, courtesy of Professors Ralph T. King and W. A. Dence; (NM) the United States National Museum collection, courtesy of Dr. Waldo L. Schmitt; (NY) the New York State Museum collection, Albany, kindness of Dayton Stoner, State zoologist. To the institutions and persons named I am much indebted for the opportunity to study these specimens.

INTRODUCED VERSUS NATIVE EARTHWORMS

It is the opinion of the specialists on earthworms (e.g., Michaelsen, 1903; Smith, 1928; Gates, 1929; Stephenson, 1930) that while an individual worm can not travel far by its own activity, nevertheless some species are carried very frequently for long distances by human agency, as among the roots of plants shipped for horticultural purposes, and thus are introduced into foreign countries. In Santiago, Chile, for instance, Michaelsen found thousands of worms of familiar European species to one native Chilean, but when he collected in the interior, in small towns less subject to European contacts, he found many Chilean species as well. Likewise in western Australia European species of Lumbricidae are practically the only earthworms found near towns. In India, Ceylon, New Zealand, South Africa, and elsewhere in European settlements, the same is true. Apparently the introduction of these adaptable and hardy kinds may cause the decline or disappearance of local species.

In the United States, species that are well known in Europe have appeared at widely separated points, such as San Francisco, New York, and Illinois, and at least in a few cases (Smith, 1928) they are known to have spread since their first discovery, increased in numbers, and to a large extent replaced American species. The predominant family in Europe and North America is Lumbricidae, which accordingly is suited to climatic changes. One abundant species, *Allolobophora caliginosa*, survives equally well winter temperatures of 40°–50° below zero in northern New York, and summer heat of 120° in the shade in the Punjab Province of India. In Europe and North America the chance of being transported by land or by sea is relatively great because of the amount of trade and travel. It would be surprising, therefore, if Lumbricidae were not introduced into new habitats much

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more frequently than some of the tropical families of earthworms.

American species have appeared in Europe at least twice: *Sparganophilus eiseni* in the banks of the Thames; *Eisenia carolinensis* at Hamburg.

It must be left to later studies to determine what effect introduced earthworms have upon soil and soil productivity. That they are introduced and do live successfully where Europeans settle has not been questioned seriously.

FEATURES OF EARTHWORMS

Fig. 1 shows the more obvious external characters of a sexually mature *Lumbricus terrestris*. A good hand lens, or better still a low-power dissecting microscope, is necessary to see many of these. Earthworms are hermaphroditic, but fertilization of the eggs

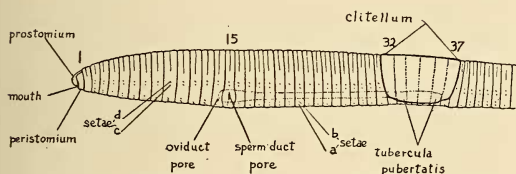


FIG. 1.—External characters of sexually mature earthworm (*Lumbricus terrestris*).

is accomplished by an exchange of sperm between one individual and another; afterward each of the pair releases its own eggs into a small capsule, which is secreted by its girdle or clitellum and slips off over the forward end. Most of the characters used in identifying species appear only in mature worms. Therefore it is necessary to collect individuals that have a clitellum, although immature ones from the same location can often be identified by their general resemblance to the mature.

CHARACTERS INDEPENDENT OF SEXUAL MATURITY

Condition of the prostomium.—This is the first apparent segment of the body. It is not counted as a segment because it lies above and in front of the mouth and does not contain the usual segmental organs. On the upper (dorsal) surface the prostomium

may send a tongue backward on the surface of the first true segment (peristomium). If this tongue goes all the way to the following groove, completely dividing the top of the peristomium, then the worm is practically certain to be a species of *Lumbricus*. If the peristomium is not completely divided on top, it belongs to another genus.

Arrangement of setae.—The minute bristles or setae of an earthworm number eight to the segment in the kinds found in the Northeastern States, although some southern and tropical worms have a great many more. These eight are usually in four pairs, as shown in the figure, but in some species the pairing is so distant that they are described as separate, or widely paired. The four setae on each side occupy about the same positions in successive segments and therefore form four rows running lengthwise. These rows, beginning with the most ventral, are called *a*, *b*, *c*, and *d*.

Color.—Most earthworms are pale pinkish, with little pigment or none. Others are dark reddish brown or purplish (*Lumbricus*, *Sparganophilus*). In these pigmented kinds the color is heaviest at the forward end and on the upper side. Often a dark line runs along the dorsal side. This is in part the dorsal blood vessel, which lies above the digestive canal, close to the body wall. Worms sometimes show iridescence, or physical color (bluish or purple) independent of pigment. A conspicuously green worm is *Allolobophora chlorotica*.

CHARACTERS DEPENDENT ON SEXUAL MATURITY

Clitellum.—In a zone covering several segments the cuticle becomes raised and smooth, so that intersegmental furrows wholly or partly disappear. The number of segments covered may be determined by looking on the ventral surface, which as a rule is not affected, or the tips of the setae may be visible through the swollen girdle. It is almost always necessary to determine, by counting, which segments bear the clitellum. Some species are extremely constant in this feature (*Octolasion lacteum*), others vary as much as three or four segments one way or the other, so that addi-

tional characters are required. In the key the location of the clitellum is given by the numbers of the first and last segments it covers; e.g., 25, 26–29, 30 means that it begins on 25 or 26 and goes to 29 or 30.

Tubercula pubertatis.—On each side of the clitellum near its lower edge may appear a series of two or three small swellings on successive or alternate segments, or a ridge reaching three or four or five segments. Their location is within the limits of the clitellum, but they are sometimes absent. If on alternate segments the numbers are separated by colons; e.g., 31:33:35; if in a ridge or on adjoining segments, a dash is used; e.g., 28–30.

Openings of sperm ducts.—In the majority of North American earthworms the sperm ducts open low on each side of segment 15, thus in front of the clitellum, but there are several exceptions to this. Also species sometimes differ in the presence or absence of a swelling or papilla at the opening of the duct.

Openings of oviducts.—As a rule these are very small pores, one on each side of segment 14, lower than the sperm duct opening. They are less frequently used in classification.

Spermathecae (or seminal receptacles) are internal pouches which receive the sperm from another individual. Their pores open on the upper part of each side in the grooves between certain segments, which are designated as grooves 8/9, 9/10, etc., meaning those between 8 and 9, between 9 and 10, and so on.

Sperm sacs (or seminal vesicles) are the internal pouches which hold the sperm produced by the same individual, prior to its discharge. They can only be seen by dissection. When present they are usually in some or all of segments 9–12.

USE OF THE KEY

In using the following key to identify an unfamiliar species, one should read first the statement marked *A*, and decide whether it fits the worm; if not, go to *AA*. If this then agrees, make a similar choice between *B* and *BB*, then *C* and *CC*, and so on, until the name of the species is reached. In a few cases there are three alternatives presented, as in the genus *Allolobophora*: *I*, *II*, and *III*. In such a case one is to be chosen.

In “running down” a worm that turns out to be *Lumbricus terrestris*, for example, we would meet the following characters:

- AA. Not threadlike; segments less than 250.
- BB. Clitellum begins behind 15; sperm duct pores in front of clitellum.
- CC. Prostomium completely divides peristomium . . .
- DD. Clitellum begins behind 28; sperm duct pores with distinct papillae.
- E. Clitellum 32–37; tub. pub. 33–36 . . .

One does not, therefore, go through the whole key, but simply picks out the appropriate choices. If a contradiction should come up, so that the specimen at some point in the key does not fit either of the choices given, then one of the following must be the case:

1. It is a species not hitherto known from this region.
2. It is an abnormal variation, such as may spoil a key character perhaps once in a hundred times.
3. A mistake has been made at a previous point in the key.
4. The key is at fault, which is entirely possible.

For localities outside the Northeastern States this key will not be satisfactory because other species may be found. Characters given in the key should not be taken as adequate for genera or families.

KEY TO EARTHWORMS OF NORTHEASTERN STATES, WITH DISTRIBUTION RECORDS

- A. Threadlike; segments 400–500; length 12–21 cm. Setae in 2 ventral and 2 dorsal rows (each side), the dorsal sometimes absent. Clitellum ring-shaped. *Haplotaxis emissarius* (Forbes, 1890). HAPLOTAXIDAE
Fairmont, Ind., Havana, Ill., Hampton, Va. (NM); Ohio (O, '28). These slender worms, pale red and iridescent when alive, are aquatic, living in underground water, marshes, and wells. Native.
- AA. Not threadlike; segments less than 250.
- B. Clitellum begins at or in front of segment 15. Sperm duct pores behind clitellum.
- C. Clitellum on 13–18; setae widely paired. . . . *Diplocardia* Garman, 1888. MEGASCOLECIDAE

- d. Clitellum a complete girdle. Length 5-10 cm. *D. singularis* (Ude, 1893)
Indiana (H, '15); Illinois (S, '28); Ohio (O, '28). This species is reported from stream banks and under logs; scattered, but locally common. Native.
- dd. Clitellum not a complete girdle.
- e. Sperm duct pores on 19.
- f. Spermathecal pores in grooves 6/7-8/9. Last hearts in 12. Length 20-30 cm. *D. communis* Garman, 1888
Illinois (S, '28); southwestern Ohio (O, '28). *Diplocardia communis* is described as common in upland soil about Urbana, Ill., but less numerous since the introduction of the European *Lumbricus terrestris* about 1896. Native.
- ff. Spermathecal pores in grooves 7/8, 8/9. Last hearts in 13. Length 20-25 cm. *D. riparia* Smith, 1895
Indiana (H, '15); Illinois (S, '28); central Ohio (O, '28). This worm is reported in wooded pastures, rich bottomland, along streams or beside ponds. Native.
- ee. Sperm duct pores on 20; length 7-15 cm. *D. verrucosa* Ude, 1895
Illinois (S, '28); Nebraska (G, '29). Native.
- cc. Clitellum on 15-25; setae closely paired; sperm duct pores on 19.
. *Sparganophilus eiseni* (Smith, 1895). GLOSSOSCOLECIDAE
Indiana (H, '15); Illinois (S, '28); Ohio (O, '28); New York (O, '40); Massachusetts, Florida, Michigan, Wisconsin, Louisiana, Mexico, Guatemala (G, '35). New records: Squaw Bay, Lake Erie (NM); Ashokan, New York (AM); north shore Oneida Lake, New York, marshy stream edge (FC); West branch Fish Creek, below Kasoag Lake, Oswego County, New York, under stone at edge of water (FC); edge of Susquehanna River, 4 miles southwest of Owego, New York, in wet mud (E). Ithaca, New York, wet mud (E). This is a slender species, 15-20 cm long, with 165-220 segments, pink with a bluish or purplish sheen when alive. It lives in very wet mud, beside or in streams or lakes. There is a record of its occurrence in the Thames River, England, probably by introduction from the United States. Native.
- bb. Clitellum begins behind 15; sperm duct pores in front of clitellum. LUMBRICIDAE
- c. Prostomium does not completely divide peristomium.
- d. Clitellum begins in front of 30.
- e. Clitellum does not reach as far back as 28. *Eiseniella tetraedra* (Savigny, 1826)
Massachusetts, Pennsylvania, Ohio, Indiana, Illinois, Michigan, Colorado, California, Washington (G, '35); New York (O, '40). New records: Cascadilla gorge, Ithaca, New York (13, 15. E); banks of Susquehanna River below Owego, New York (13, 15. E); highly organic mud beside pond, Waverley, New York (13. E); edge of creek, McLean bogs, Tompkins County, New York (13. FC); Cedarvale, New York, under stones, edge of creek (15. FC); Pratts Falls, Onondaga County, New York, along creek (11, 13. FC); Cascades near Collingwood, Onondaga County, New York (11. FC); Bronx County, New York City (11, 13. AM); Edgewater, New Jersey (13. AM); Meech's Island, Shelburne, Vermont, in lake, under stones (NY); Rock Creek Park, Washington, District of Columbia, near creek, in wet mud (13. E). European. The numbers in parentheses refer to the segment bearing the sperm duct pores in various specimens. This is a variable feature in *Eiseniella tetraedra*; several "varieties" have been named according to this and the position of the clitellum, which likewise varies:
Clit: 22 or 23-26 or 27 Spd. pores 13. *typica*
Clit: 23 or 24-27, 28, 29 Spd. pores 15. *hercynia*
Clit: 20 or 21-24 or 25 Spd. pores 11. *hammoniensis*
Clit: 20 or 21-24 or 25 Spd. pores 13. *neapolitana*
Clit: 20 or 21-24 or 25 Spd. pores 15. *ninnii*
- Since two or more of these varieties often occur together in one locality, they are probably not subspecies but standardized individual variations, like the black and cinnamon bears. Probably the difference is due to assortment of genetic allelomorphs. The species is small, usually 3-6 cm, and the posterior part has a four-cornered rather than cylindrical form in most specimens. It has a wide range in the Old World. The preferred habitat is wet or polluted banks of streams and ponds.
- ee. Clitellum reaches at least as far back as 28.
- f. Spermathecal pores dorsal to seta line *d*. *Eisenia* Malm, 1877
- g. Setae widely paired, ab:bc:cd = 5:9:5. *E. veneta hortensis* Michaelsen, 1890
Europe, Africa, South America, San Francisco, California (S, '17), Cleveland, Ohio (G, '42). A stream-bank species, Illinois (S, '28). European. The clitellum is on 26, 27-32, 33; tubercula pubertatis 30-31; spermathecal pores in grooves 9/10, 10/11; segments 80-120; length 4-10 cm.
- gg. Setae closely paired.
- h. Spermathecal pores in furrows 8/9, 9/10, 10/11; clitellum 24-30.
. *E. lönnbergi* (Michaelsen, 1894)

Georgia, North Carolina, Virginia, Maryland, Massachusetts (G, '35); Connecticut (G, '42). Native. The record from Massachusetts refers to a white pine-hemlock-hardwood forest.

HH. Spermathecal pores in furrows 9/10, 10/11.

- i. Each segment ringed with a brown line; clitellum 24, 25, 26-32; tub. pub. 28-30, 31. *E. foetida* (Savigny, 1826)

Europe; introduced into the United States where it is common and widespread. New records: Compost heaps, Onondaga Hill, New York (FC); Syracuse, New York (FC); Brooklyn, New York, under humus and rotten vegetables (AM); in rubbish heap and humus, Bergen Beach, New York (AM); Edgewater, New Jersey (AM); Ashokan, New York (AM); Kenwood, New York, under log in earth (NY); Howes Cave, New York (NY); pasture, streambank, Ithaca, New York (E). The published records of habitats include manure heaps, sewer outlets, polluted stream-banks, decaying straw, dead logs, and similar places where moisture and organic content are both high. The length is 6-13 cm, and the banded appearance is the most obvious character of this worm.

II. Segments not ringed with brown.

- J. Tub. pub. 29-31; clitellum 24, 25, 26-31, 32, 33. . . *E. rosea* (Savigny, 1826)

Europe, Maine, New York, Georgia, Indiana, Illinois, Louisiana, Arizona, California (S, '17); Ohio (O, '28). European. New records: Pratts Falls, Onondaga County, New York, under stones by creek (FC); Syracuse, New York, in "heap of clay," on sidewalks, and in alfalfa field (FC). The length is 3-8 cm, the color pale pinkish. A general characteristic of preserved specimens is that the clitellum is swollen to about twice the diameter of the adjacent parts of the body.

- JJ. Tub. pub. 27-29; clitellum 24-31. *E. carolinensis* Michaelsen, 1903

This species was described from a specimen introduced with plants into Hamburg from Fayetteville, North Carolina (S, '17), a second example of transfer from America to Europe. Native. Length 3.5 cm.

FF. Spermathecal pores, if present, in or ventral to seta line *d*.

- G. More than 2 pairs of sperm sacs; spermathecae present.

H. Setae closely paired; sperm sacs in 9-12. *Allolobophora* Eisen, 1874

- i. Tub. pub. 31:33 or 31-33; clitellum 24, 25, 26, 27, 28-32, 33, 34, 35. *A. caliginosa* (Savigny, 1826)

Europe; the most abundant, widespread, and ecologically adaptable species in the United States. New records: (New York) Along brook in pasture below Cascades, south of Collingwood, Onondaga County (FC); alfalfa lot, Syracuse (FC); Pack Forest, Warrensburg (FC); Whetstone Gulf, stream side (FC); Jamesville, Onondaga County (FC); Junius Ponds area, Ontario County (FC); Ithaca: Fall and Cascadilla gorges, lawns, McGowan woodlot (E); dry ditch beside field, and bank of Susquehanna River, below Owego (E); Rose, Wayne County, in coarse mull and in woody peat (virgin and cultivated) (E); Potter, Yates County, in woody peat (E); Palmyra, Wayne County, in coarse mull under hardwood forest (E); McLean, Tompkins County, in fine mull in forest (E); Newcomb, Essex County, in grassy fields (E); New York City (AM). (Pennsylvania) Polluted stream bank, Sayre (E). (New Jersey) Alpine, Palisades near Edgewater, Edgewater (AM). This species shows a variability similar to that of *Eiseniella tetraedra*, in that two "varieties" have been named. But the distinction here concerns the tubercula pubertatis: in var. *typica* they are separate swellings on 31:33; in var. *trapezoides* they form ridges extending from 31-33. In many specimens it is difficult to decide which condition is present, and the two forms very generally occur together. In New York State *trapezoides* seems to be slightly more frequent. In Ohio (O, '28) and Illinois (S, '28) it is described as much more abundant than *typica*. The clitellum also varies in position, being most frequently about 27-34. Again I do not believe that these differences have subspecific value, since neither in Europe nor in America are they geographically significant, but suggest rather that one or more pairs of genetic allelomorphs may be responsible, the proportions varying among different populations of the species. The use of trinomials would then be misleading. This worm is pale pinkish; length 6-17 cm.

- II. Tub. pub. 32-34; clitellum 27, 28-35. *A. longa* Ude, 1885

Europe, Maine, Grand Manan, Toronto, Indiana (S, '17); Connecticut (G, '42). New records: Region of New York City (AM); Brooklyn, New York, under stones, humus, rotten vegetables (AM); pasture near McLean bogs, Tompkins County, New York (E). In size and general appearance this species is much like *A. caliginosa*. Only determination of the segments bearing the tubercula pubertatis will separate them externally.

- III. Tub. pub. 31:33:35; clitellum 29-37; color greenish when alive or freshly preserved..... *A. chlorotica* (Savigny, 1826)
- Europe, Greenland, Vancouver, Mexico, Guatemala, North Carolina, District of Columbia, Indiana, Colorado, California (S, '17); Ohio (O, '28); Illinois, stream banks (S, '28). New records: (New York) Syracuse (FC); Ithaca, Cascadilla gorge (E); bank of Susquehanna River below Owego, in mud and in dead wood (E); greenhouse, New York City (AM); Rensselaer (NY). (Pennsylvania) Polluted creek bank, Sayre (E). (Maryland) Bethesda (NM). This worm prefers wet and usually highly organic or polluted soil. Fresh specimens in formalin are grass-green, with a contrasting pink clitellum, which is as near as any earthworm comes to beauty. The length is 5-7 cm.
- HH. Setae separate or widely paired; sperm sacs in 9, 11, 12..... *Dendrobaena* Eisen, 1874
- I. Clitellum 25, 26-31, 32; tub. pub. 28-30.... *D. subrubicunda* (Eisen, 1874)
- Europe, Newfoundland, Niagara, Illinois, Colorado, California (S, '17); Indiana (H, '15); Ohio (O, '28); Massachusetts (G, '35). New records: Ashokan, New York (AM); Alpine, New Jersey (AM). This species is described as common in a polluted stream-bank in Illinois (S, '28). Length, 4-7.5 cm.
- II. Clitellum 27, 28, 29-33, 34; tub. pub. 31-33.. *D. octaedra* (Savigny, 1826)
- Europe, northern Asia, Iceland, Greenland, Newfoundland, Mexico, Colorado (S, '17); Illinois (S, '28). New record: Lake Placid, New York (FC). Length, 2.5-4 cm.
- GG. Two pairs of sperm sacs, in 11, 12. Spermathecae absent (or imperfectly developed in *B. tenuis*)..... *Bimastos* Moore, 1893
- H. Setae closely paired.
- I. Clitellum covers less than 10 segments.
- J. Clitellum begins on or in front of 23.
- K. Clitellum on 23-28..... *B. palustris* Moore, 1895
- Pennsylvania, New Jersey, North Carolina (G, '29). Native. This species is found in wet soil beside ponds or streams. There is a prominent swelling enclosing a cavity at the opening of each sperm duct. Tubercula pubertatis are lacking. Length, to 7.5 cm.
- KK. Clitellum 20, 22-29, 30; *ab* greater than *cd*.. *B. gieseleri* (Ude, 1895)
- Georgia, Florida, Ohio, Illinois, Kansas, Texas (G, '29); Indiana (O, '28). Native. Specimens from Florida and Georgia have clitellum 20-30, and are called var. *typica*. Some from Florida and those from the other States named have it located on 22-29, 30: var. *hempeli* Smith, 1915. The habitat is rotten wood, decaying logs, and leaf accumulations. Length, 5-8 cm.
- KKK. Clitellum 22-29; *ab* = *cd*..... *B. tumidus* Eisen, 1874a
- Mount Lebanon, New York. Native. The only record since Eisen (1874a) is a report by Olson (1940) of specimens found "near Oneida Lake."
- JJ. Clitellum begins on or behind 24.
- K. Clitellum 24-30; tub. pub. (indistinct) 25, 26-29, 30..... *B. parvus* (Eisen, 1874a)
- New York, Michigan, Kansas, California, Louisiana, Mexico, Guatemala, also China, Japan, Africa (S, '17); Ohio (O, '28); Massachusetts (G, '35). New record: Ashokan, New York (AM), not Pratts Falls (O, '40). Native. Length, 2.5-4 cm.
- KK. Clitellum 24, 25-31; tub. pub. (indistinct) 24, 25-30..... *B. beddardi* (Michaelsen, 1894)
- Michigan, Illinois, Montana, Florida, California, Washington, Hawaii (S, '17); Ohio, near end of Lake Erie (O, '28). Native. This is found in "wet situations and in decaying logs, stumps, or moss" (S, '17).
- KKK. Clitellum 25-32 (slightly on 33)..... *B. heimbürgeri* (Smith, 1928)
- This species is described from a specimen found in a stream bank below White Heath, Illinois. The tubercula pubertatis are apparently absent, there is very little pigmentation, and the length of the specimen is 7.7 cm. Smith notes a close resemblance to *B. palustris*.

II. Clitellum covers 10 or 11 segments.

J. Clitellum 23-32 or 24-33. *B. longicinctus* (Smith and Gittins, 1915)

Urbana, Illinois (S, '17); southeastern Ohio (O, '28). Smith describes this worm as common in lawns and woods, while Olson reports it from a wet, wooded ravine, under leaves. Length, 6-9 cm. No tubercula pubertatis. Native.

JJ. Clitellum 27-37. *B. zeteki* (Smith and Gittins, 1915)

Illinois, Indiana, Michigan (S, '17); Susquehanna River, New York (G, '29); southwestern Ohio (O, '28). Native. This species occurs in soil under logs or decaying leaves, and in dead logs under the bark. Length, 10-14 cm.

HH. Setae widely paired. *B. tenuis* (Eisen, 1874a)

Europe, Asia, Alaska, Bering Island, Canada, Vancouver Island, Mexico, South America, Maine, New York, Ohio, Illinois, Indiana, Michigan, Colorado, California, Washington (S, '17); Massachusetts (G, '35); Connecticut (G, '42). It is difficult to judge from these records whether this species was originally North American, European, or circumpolar. The first specimens were those described by Eisen from New York State. Smith (1917) considers the European *B. constrictus* (Rosa, 1884) to be the same species. These worms favor rotting logs, decaying leaves, hay, or manure piles.

DD. Clitellum on 30-35; setae widely paired. *Octolasion lacteum* (Örley, 1881)

Europe, Mexico, Colorado, California, Indiana, Illinois, Ohio (S, '17); Connecticut (G, '42). New records: (New York) Ithaca: Fall Creek and Cascadilla gorges (E); McLean bogs, Tompkins County, in fine black mull and in pasture (E, FC); Ringwood preserve, Freeville, Tompkins County, in leaf mat (E); Arnot Forest, Van Etten, stream side (E); Potter, Yates County; in woody peat (E); south side of Susquehanna River, below Owego, in wet decaying wood (E); Ashokan (AM); Bergen Beach (AM); Syracuse (FC); White Lake, Onondaga County (FC); Pratts Falls, Onondaga County, along creek (FC); under stones along creek, Cedarvale (FC); Cascades, Butternut Creek, Onondaga County, along brook in open pasture (FC); South Pond area, North Constantia, Oswego County (FC); Salmon River, in woods south of Parish, Oswego County. (FC). As these records show, *O. lacteum* favors, but is not limited to, moist and highly organic soil. Smith (1928) describes it as an upland and streambank species in Illinois. The length is highly variable, 5-16 cm, but the position of the clitellum combined with wide separation of the seta rows makes this species easy to recognize.

cc. Prostomium completely divides peristomium by means of an extension backward on the dorsal side, to the second furrow. *Lumbricus* Linnaeus, 1758

D. Clitellum begins on or in front of 28; sperm duct pores without distinct papillae.

E. Clitellum on 26, 27-32; color red. *L. rubellus* Hoffmeister, 1843

Europe, Siberia, Newfoundland, Washington, Oregon, California, Michigan (S, '17); Ohio, near Toledo (O, '28); Massachusetts (G, '35). New records: Ithaca, New York, Fall Creek gorge (E); banks of Susquehanna River, between Owego and Waverley, New York, in mud and dead wood (E); McLean bogs, Tompkins County, New York, in wet mull and in muck (E); Rose, Wayne County, New York, in woody peat, in forest (E); polluted creek bank, Sayre, Pennsylvania (E); Rock Creek Park, Washington, District of Columbia, beside stream (E). This worm seems to require a great deal of moisture and organic matter. It and the other three species of *Lumbricus* listed here are European. Length, 7-15 cm.

EE. Clitellum on 28-33; dark red. *L. castaneus* (Savigny, 1826)

Europe, Canada, New York (S, '17); Massachusetts (G, '35); Syracuse, New York (FC). A smaller species. Length, 6-10 cm.

DD. Clitellum begins behind 28; sperm duct pores with distinct papillae.

E. Clitellum 32-37; tub. pub. 33-36. *L. terrestris* Linnaeus, 1758

Europe, Mexico, Newfoundland, Maine, Massachusetts, New York, Connecticut, Maryland, District of Columbia, Ohio, Michigan, Illinois, Minnesota, Colorado, California (S, '17). Smith (1928) says that in Illinois this familiar species has become abundant after being first reported about 1896 and has tended to replace the native American *Diplocardia communis*. In Ohio Olson (1928) says it has become widely distributed "in the last ten years." It is present abundantly in New York State, from numerous localities, but not the Adirondack Forest so far as known. The habitats include coarse mull soil in forests or fields, mud beside streams, lawns, woody peat, and the inside of a rotten log. Length, 10-30 cm.; color, reddish brown, especially forward.

EE. Clitellum 34-39; tub. pub. 35-38. *L. festivus* (Savigny, 1826)

This is a European species reported from Canada (S, '17), but not yet from the United States.

REFERENCES

- EISEN, G. *Om Skandnaviens Lumbricider*. Öfv. Vet. Akad. Förh. **30**: 43-56. 1874.
- . *Bidrag till Kännedom om New Englands och Canadas Lumbricider*. Öfv. Vet. Akad. Förh. **31**: 41-49. 1874a.
- FORBES, S. A. *On an American earthworm of the family Phreoryctidae*. Bull. Illinois State Lab. Nat. Hist. **3**: 107-116. 1890.
- GARMAN, H. *On the anatomy and histology of a new earthworm (Diplocardia communis gen. et sp. nov.)*. Bull. Illinois State Lab. Nat. Hist. **3**: 47. 1888.
- GATES, G. E. *The earthworm fauna of the United States*. Science **70**(1811): 266-267. 1929.
- . *The earthworms of New England*. Proc. New England Zool. Club **15**: 41-44. 1935.
- . *Check list and bibliography of North American earthworms*. Amer. Midl. Nat. **27**(1): 86-108. 1942.
- HEIMBURGER, H. V. *Notes on Indiana earthworms*. Proc. Indiana Acad. Sci. **1914**: 281-285. 1915.
- HOFFMEISTER, W. *Beitrag zur Kenntnis deutscher Landanneliden*. Arch. Naturg. **9**: 183-198. 1843.
- LINNAEUS, CAROLUS. *Systema naturae*, ed. 10. 1758.
- MALM, A. W. Öfv. Hortik. Förh. Göteborg **1**: 45. 1877.
- MICHAELSEN, W. *Oligochaeten des naturhistorischen Museums in Hamburg*. Mitt. Mus. Hamburg **7**. 1890.
- . *Die Regenwurm-Fauna von Florida und Georgia*. Zool. Jahrb., Abt. Syst. **8**: 177-194. 1894.
- . *Die Lumbriciden-Fauna Nordamerikas*. Abh. nat. Ver. Hamburg **16**: 1-22. 1900.
- . *Die geographische Verbreitung der Oligochaeten*, 186 pp. Berlin. 1903.
- MOORE, H. F. *Preliminary account of a new genus of Oligochaeta*. Zool. Anz. **16**: 333-334. 1893.
- . *On the structure of Bimastos palustris, a new oligochaete*. Journ. Morph. **10**: 473-496. 1895.
- OLSON, H. W. *The earthworms of Ohio*. Ohio Biol. Surv. Bull. **17**: 46-90. 1928.
- . *Earthworms of New York State*. Amer. Mus. Nov., No. **1090**: 1-9. 1940.
- ÖRLEY, L. *A Magyarországi Oligochaeták Faunája. I. Terricolae*. Math. Term. Közlem. Magyar Akad. **16**: 563-611. 1881.
- . *A palearktikus övben élő terrikolának revisiója és elterjedése*. Ertek. term. Kör. Magyar Akad. **15**: 1-34. 1885.
- ROSA, D. *Revisione dei Lumbricidi*. Mem. Accad. Sci. Torino (2) **43**: 397-476. 1893.
- SAVIGNY, J. C. *Analyse d'un mémoire sur les lombrics par Cuvier*. Mem. Acad. Sci. Inst. France **5**: 176-184. 1826.
- SMITH, FRANK. *Notes on species of North American Oligochaeta*. Bull. Illinois State Lab. Nat. Hist. **4**: 285-297. 1895.
- . *Two new varieties of earthworms, with a key to described species in Illinois*. Bull. Illinois Lab. Nat. Hist. **10**: 551-559. 1915.
- . *North American earthworms of the family Lumbricidae in the collections of the U. S. National Museum*. Proc. U. S. Nat. Mus. **52**: 157-182. 1917.
- . *An account of changes in the earthworm fauna of Illinois, and a description of one new species*. Bull. Div. Nat. Hist. Surv. Illinois **17**(10): 347-362. 1928.
- and E. M. GITTINS. *Two new species of Lumbricidae from Illinois*. Bull. Illinois State Lab. Nat. Hist. **10**: 545-550. 1915.
- STEPHENSON, J. *The Oligochaeta*. Oxford. 1930.
- UDE, H. *Über die Rückenporen der terricolen Oligochaeten, nebst Beiträgen zur Histologie des Liebesschlauches und zur Systematik der Lumbriciden*. Zeitschr. wiss. Zool. **43**: 87-143. 1885.
- . *Beiträge zur Kenntnis ausländischer Regenwürmer*. Zeitschr. wiss. Zool. **57**: 57-75. 1893.
- . *Beiträge zur Kenntnis der Enchytraeiden und Lumbriciden*. Zeitschr. wiss. Zool. **61**: 111-141. 1895.